

**NASA**

**SECTION 19**

## Summary and Conclusion

- Impact analysis (“Crater”) indicates potential for large TPS damage
  - Review of test data shows wide variation in impact response
  - RCC damage limited to coating based on soft SOFI
- Thermal analysis of wing with missing tile is in work
  - Single tile missing shows local structural damage is possible, but no burn through
  - Multiple tile missing analysis is on-going
- M/OD criteria used to assess structural impacts of tile loss
  - Allows significant temperature exceedance, even some burn through
    - ◆ Impact to vehicle turnaround possible, but maintains safe return capability

### Conclusion

- Contingent on multiple tile loss thermal analysis showing no violation of M/OD criteria, safe return indicated even with significant tile damage



## Michele Lewis

From:  
Sent:  
To:

DISLER, JONATHAN M. (JON) (JSC-SX) (LM)  
Sunday, January 19, 2003 9:30 PM  
Armando Oliu (E-mail); BAHR, PATRICIA A. (PAT) (JSC-SJ) (NASA); CONTE, BARBARA A. (JSC-DM) (NASA); Bill Lamkin; SWAN, BOBBIE G. (JSC-CA) (NASA); ELIASON, BRENDA J. (JSC-EA6) (NASA); BALU, BRIAN K. (JSC-NC) (SAIC); ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA); CLOUDT, CHRIS R. (JSC-SX) (HEI); HADFIELD, CHRIS (JSC-CB) (CSA); Chris Lessmann; BOYKIN, CHRISTINE M. (JSC-MS2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA); CLEMENTS, DANIEL L. (JSC-NC) (GHG); BROWN, DAVID M. (JSC-CB) (NASA); MOYER, DAVID S. (JSC-MV5) (NASA); BRETZ, DAVID R. (JSC-SX) (HEI); David Rigby / MPS SSM (E-mail); HAYNES, DENA S. (JSC-EV) (NASA); PREVETT, DONALD E. (DON) (JSC-EP) (NASA); MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); Doug White; Douglas Powell (MAF); MAYER, FRED F. (JSC-NC) (SAIC); Gail Hargrove Boeing-Houston Imagery Scrn.; Greg Katnik; GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA); BYRNE, GREGORY J., PHD (JSC-SX) (NASA); WALTERS, JAMES B. (BRITT) (JSC-SM) (NASA); 'James Feeley' (E-mail); WALTERS, JAMES B. (BRITT) (JSC-SM) (NASA); JIMENEZ, JAVIER J. (JSC-EB) (LM); Jeff Goodmark (E-mail); RICHART, JENE A. (JSC-MS2) (NASA); LIN, JILL D. (JSC-MV5) (NASA); Jim Harder; 'John McKee' (E-mail); John Ventimiglia; DISLER, JONATHAN M. (JON) (JSC-SX) (LM); Jorge Rivera; KRAMER, JULIE A. (JSC-EA4) (NASA); Karen Alfaro (E-mail); BROWN, KENNETH L. (JSC-MV6) (NASA); CROSBY, KEVIN L. (JSC-SX) (LM); 'L Lohrli' (E-mail); Malcolm Glenn; ERMINGER, MARK D. (JSC-NC) (NASA); ERMINGER, MARK D. (JSC-NC) (NASA); HOLDERMAN, MARK L. (JSC-MS3) (NASA); IVINS, MARSHA S. (JSC-CB) (NASA); MARTINEZ, HUGO E. (JSC-NC) (GHG); ANDERSON, MICHAEL P. (JSC-CB) (NASA); SNYDER, MICHAEL W. (JSC-SX) (LM); Mike Cagle / Boeing Film Screen; Mike O'farrell; BERTSCH, P. J. (JEFF) (JSC-DM2) (NASA); Pam Madera (E-mail); DYE, PAUL F. (JSC-DA8) (NASA); PAYNE, ROBERT W. (JSC-SA13) (LM); 'Philip Kopfinger' (E-mail); Philip Peterson / Boeing Film Screen (E-mail); Philip Reid / Boeing Film Screen; SAGANTI, PREMKUMAR, PHD (JSC-SF) (LM); ADAMS, RANDALL W. (JSC-MA2) (NASA); SILVESTRI, RAYMOND T. (RAY) (JSC-DM4) (NASA); HUSBAND, RICK D. (JSC-CB) (NASA); Robbie Robinson; Robert Page; SCHARF, ROBERT (JSC-SX) (LM); Robert Speece; FRICKE, ROBERT W., JR (JSC-MV) (LM); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); WALLACE, RODNEY O. (ROD) (JSC-MS2) (NASA); Rohit Dhawan; CLAYTON, RONALD G. (RONNIE) (JSC-MS2) (NASA); GLANVILLE, ROY W. (JSC-NC) (NASA); Rudy Ramon; SA REP; Sara Brandenburg; Scott Otto; FRICK, STEPHEN N., CDR. (JSC-CB) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); Tom Rieckhoff; Tom Wilson; 'Treith' (E-mail)

Subject:

JSC STS-107 Launch Film Screening Report

STS-107  
Launch Film Screening Report  
January 20, 2003  
JSC Image Science and Analysis Group  
Human Exploration Science Office / SX

### ANOMALY

E204, E208, E212- During ascent at approximately 81 seconds MET, a large light-colored piece of debris was seen to originate from an area near the ET/Orbiter forward attach bipod. The debris appeared to move outboard in a -Y direction, then fell aft along the left Orbiter fuselage, and struck the underside (-Z) of the leading edge of the left wing. The strike appears to have occurred on or relatively close to the wing glove near the Orbiter fuselage. After striking the left wing, the debris broke into a spray of white-colored particles that fell aft along the underside (-Z side) of the

Orbiter left wing. The spray of particles was last seen near the LSRB exhaust plume.

Comparison views of the strike area immediately before and after the vent were examined for indications of damage to the wing. The resolution on the films and videos is insufficient to see individual tiles. However, no indications of damage at a larger scale as indicated by changes in brightness of the wing surface area(s) that may indicate damage was noted.

Still views and enhanced movie loops of this event are available for at the following web address:

<[http://sn-isag.jsc.nasa.gov/shuttleweb/mission\\_support/sts-107/launch\\_video/107launchvideo.shtml](http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_video/107launchvideo.shtml)>

The times of this event are as follows:

Debris first seen near ET/Orbiter forward attach: 016:15:40:21.699 UTC  
Debris contacted left wing:  
016:15:40:21.882 UTC

Crew acquired down linked video imaging the External Tank (ET), probably the source of the debris that struck the Orbiter left wing, was reviewed. Unfortunately the view is of the far side of the ET and provided no information as to the source of the debris object.

A down linked view of the Orbiter left wing upper surface from a payload bay camera did not image the suspected impact area.

#### OBSERVATIONS:

Selected launch views are available for viewing at:

<[http://sn-isag.jsc.nasa.gov/shuttleweb/mission\\_support/sts-107/launch\\_film/107launchfilm.shtml](http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_film/107launchfilm.shtml)>

Other launch film screening event observations similar to those seen on previous missions are:

On the launch video screening report dated 1/16/03 we reported that the right elevon motion may have been greater on STS-107 than has been typically seen. A comparison of the elevon motion was done with views from STS-113 and the previous Columbia flight (STS-109). It was concluded that the motion on STS-107 was normal in that it was similar to the elevon motion seen on STS-113 and STS-109.

E5, E17, E18, E19, E20 - Orange vapor (possibly free burning hydrogen) was seen forward of the SSME rims and near the base heat shield during SSME ignition. The orange vapor on the STS-107 films appeared to be similar to those typically seen on previous mission films and videos.

E19, E20, E76 - During SSME start-up, the SSME Mach diamonds formed in the expected sequence (3, 2, 1). The times for the Mach diamond formation given below are from the engineering film E76:

SSME #3 - 15:38:56.736 UTC  
SSME #2 - 15:38:56.816 UTC  
SSME #1 - 15:38:57.227 UTC

ie start times for SSME ignition based on the E76 film were:

SSME #3 - 15:38:55.215 UTC  
SSME #2 - 15:38:55.355 UTC  
SSME #1 - 15:38:55.455 UTC

E5, E76 - Movement of the SSME #3 Dome Mounted Heat Shield (DMHS) blanket was seen during SSME ignition on camera E5. On camera E76, SSME #2 and SSME #3 DMHS blanket movement was seen during SSME ignition (15:38:56.466 UTC). This event has been seen on previous mission films.

E1, E2, E4, E5, E20, E31 - Typical of previous missions, multiple pieces of ice debris were seen falling from the ET/Orbiter umbilicals and along the body flap during SSME ignition through liftoff. Ice debris was seen falling near the LH2 umbilical four inch recirculation line. None of the debris were seen to contact the launch vehicle.

E5, E18, E20, E31 - A line of frost was visible at the juncture of the base of SSME #2 and the Dome Mounted Heat Shield (DMHS) during liftoff.

E18, E20 - Typical of previous missions, small areas of tile surface material erosion were seen forming on the base heat shield and on the SSME stingers at the following times:

15:38:56.000 UTC - Erosion mark inboard of the left RCS stinger
15:38:56.562 UTC - Erosion mark outboard of SSME #2 near the body flap
15:38:57.329 UTC - Erosion mark on the tip of the left RCS stinger
15:38:58.639 UTC - Erosion mark on the left OMS pod between the OMS nozzle and vertical stabilizer

E2, E19- Faint, light-orange-colored flashes were seen in the SSME exhaust plumes, possibly debris induced, during SSME ignition and through liftoff at the times shown below:

SSME #1 - 15:38:57.728 UTC  
SSME #1 - 15:38:58.385 UTC  
SSME #1 - 15:38:58.779 UTC  
SSME #1 - 15:38:59.019 UTC  
SSME #3 - 15:38:57.395 UTC  
SSME #3 - 15:38:59.532 UTC

Flashes in the SSME exhaust plume prior to liftoff have been seen on previous mission films.

E17 - Several small, dark-colored pieces of debris (possibly paint chips) were seen falling from a seam line on the -Z side of the LO2 TSM just

before  
liftoff (15:38:59.566 UTC).

1, E5, E17, E52 - As typically seen on previous missions, multiple pieces of SRB throat plug and/or SRB flame duct debris were seen near the right and left SRBs during liftoff. On camera E1, two pieces of SRB flame duct debris were seen arcing between the two SRB's and falling aft along the -Z side of the body flap during liftoff (15:39:00.4 UTC). On camera E17, a large appearing, light-colored piece of probable SRB throat plug material was seen aft of the vehicle during liftoff (15:39:01.873 UTC). At liftoff, light-colored debris was seen falling aft near the +Y side of the RSRB aft skirt (15:39:02.456 UTC). On camera E52, debris from the base of the SRB's was seen traveling north of the MLP at liftoff (15:39:02.203 UTC).

E5- A light-colored piece of debris was seen falling aft from near the ET/RSRB aft attach during liftoff (15:39:01.235 UTC).

E8 - SRB ignition was at 15:39:00.000 UTC based on the observation of the PIC firing at RSRB holddown post M-2.

E18 - A dark-colored, flexible, strap or tag-like object was seen on the LH2 TSM T-0 umbilical disconnect prior to liftoff.

19 - A long, dark-colored, flexible, strap-like object was seen coming from the top of the LH2 TSM T-0 door before detaching and falling aft in front of the TSM T-0 door after liftoff (15:39:03.582 UTC)

E8, E13 - The left and right SRB GN2 purge lines appeared wrapped, upright, and intact until they were obscured by exhaust plumes at 15:39:00.000 UTC (right purge line) and 15:39:00.003 UTC (left purge line).

E7, E10, E11, E14 - The left and right SRB north holddown post blast shields closed prior to when the SRB nozzle exit plane rose past the level of the SRB holddown post shoes, as they are designed to do. However, the holddown post M4 blast shield may have closed quicker than typical.

E33, E34, E36, E39, E52- The GH2 vent arm retraction appeared normal. Ice and vapors were seen falling aft along the ET during the vent arm retraction. The GH2 vent arm contact with the deceleration cable on the E39 camera close-up view from inside the FSS of the vent arm capture was visible. As designed, the arm appeared to make contact very close to the center position of the deceleration cable. The vent arm appeared to catch normally with no rebound. A measurement of the position of the vent arm with respect to the center of the deceleration cable at the time of initial contact will be made and reported separately.

E207, E212 - An assessment of the body flap motion during ascent compared to that seen on previous missions could not be made because of the soft focus of the STS-107 long range tracking camera views.

E52, E212, E213, E222, E223- Multiple pieces of debris, too numerous to count (mostly umbilical ice and RCS paper debris), were seen falling aft of the launch vehicle during ascent. Umbilical ice and RCS paper debris during ascent has been seen on previous mission films and videos. Examples are:

15:39:17.021 UTC: Forward RCS paper debris noted falling aft along the right wing (E52)

15:39:20.093 UTC: RCS paper debris noted. (E223)

15:39:20.169 UTC: Spray of RCS paper debris noted aft of the SSMEs. (E222)

15:39:23.9 UTC: Debris from ET/Orbiter umbilicals noted falling aft along body flap. (E213)

Frame 960: RCS paper debris noted falling aft of SSME exhaust plume. (E212)

E5, E20, E31, E52, E212, E222 - Pieces of orange-colored umbilical purge barrier material were seen falling aft along the -Z side of the body flap during SSME ignition (15:38:57.703 UTC). On camera E20, three pieces of light-orange colored umbilical purge barrier material were noted falling aft

near SSME #2 prior to liftoff (15:38:58.394 UTC). Umbilical purge barrier

material was seen falling along the body flap during tower clear on camera

E52. On camera E222, a piece of umbilical purge barrier material was seen

near the Orbiter right wing during liftoff (15:39:03.014 UTC). During early

ascent, multiple pieces of umbilical purge barrier material were seen falling aft of the left wing on the camera E52 view. On camera E212, a piece of umbilical purge barrier material was seen falling along the body

flap. On camera E222, a piece of umbilical purge barrier material was seen

falling aft of the body flap at approximately 32 seconds MET (15:39:31.840

UTC). Purge barrier material falling from the ET umbilicals has been typically seen on previous mission tracking camera views.

Cameras E52, E213, E220, E222, E223 - Light-colored flares (possibly debris

induced) were seen in the SSME exhaust plumes during ascent on the intermediate and long range tracking camera films. Examples of the flares

observed are:

15:39:14.576 UTC: Flare noted in SSME exhaust plume (E52)

15:39:33.178 UTC: Flare seen in SSME exhaust plume (E213)

15:39:33.424 UTC: Flare seen in SSME exhaust plume (E213)

15:39:33.471 UTC: Flare seen in SSME exhaust plume (E222)

15:39:33.475 UTC: Flare seen in SSME exhaust plume (E213)

15:39:35.469 UTC: Flare seen in SSME exhaust plume (E213)

15:39:35.633 UTC: Flare seen in SSME exhaust plume (E213)

15:39:37.175 UTC: Flare seen in SSME exhaust plume (E222)

15:39:37.177 UTC: Flare seen in SSME exhaust plume (E213)

15:39:40.367 UTC: Flare seen in SSME exhaust plume (E213)

15:39:33.168 UTC: Flare seen in SSME exhaust plume (E213)  
15:39:41.992 UTC: Flare seen in SSME exhaust plume (E213)  
15:39:51.001 UTC: Flare seen in SSME exhaust plume (E220)  
15:39:57.060 UTC: Flare seen in SSME exhaust plume (E223)

Flares in the SSME exhaust plumes have been seen on previous missions films and videos.

E204, E207, E220, E222, E223 - As on previous missions, debris was seen exiting the SRB exhaust plumes. The debris exiting the SRB exhaust plumes during the majority of ascent is probably instafoam from the aft end of the SRBs. The more dense appearing debris near the time of tail-off, just prior to SRB separation, is probably SRB slag debris. Examples of this debris are:

15:39:27.186 UTC: Debris seen falling along SRB exhaust plume (E223)  
15:39:48.926 UTC: Debris seen falling along SRB exhaust plume (E220)  
15:39:49.350 UTC: Debris seen falling along SRB exhaust plume (E223)

SRB separation was timed at 15:41:06.536 UTC on camera E207.

Other normal events observed included: RCS paper debris, ice and vapor from the LO2 and LH2 TSM T-0 umbilicals prior to and after disconnect, ET twang, multiple pieces of debris in the exhaust cloud after liftoff including rope-like debris (probable water baffle material), acoustic waves in the exhaust cloud after liftoff, charring of the ET aft dome, ET aft dome outgassing, vapor off the SRB stiffener rings, expansion waves, linear optical effects, recirculation, SRB plume brightening, and SRB slag debris after SRB separation.

Normal Pad events observed included: Hydrogen igniter operation, MLP deluge water activation, FSS deluge water operation, LH2 and LO2 TSM door closure, and sound suppression system water operation.

#### NOTES:

Twelve 16 mm films, thirteen 35 mm films, and 24 launch videos were screened. The focus on several of the long range tracking camera film views was very soft which hindered imagery analysis and the analysis of the debris strike to the Orbiter wing.

This concludes the routine JSC STS-107 launch film and video screening. Image enhancements of the debris strike event, web site updates, or other special support requests, will be performed prior to landing.

Jon Disler / SX3-LM  
Chris Cloudt / SX3-HEI  
Joe Caruana / SX3-LM

**Michele Lewis**

---

From: DISLER, JONATHAN M. (JON) (JSC-SX) (LM)  
Sent: Saturday, January 18, 2003 7:05 PM  
To: Armando Oliu (E-mail); BAHR, PATRICIA A. (PAT) (JSC-SJ) (NASA); CONTE, BARBARA A. (JSC-DM) (NASA); Bill Lamkin; SWAN, BOBBIE G. (JSC-CA) (NASA); ELIASON, BRENDA J. (JSC-EA6) (NASA); BALU, BRIAN K. (JSC-NC) (SAIC); ORTIZ-LONGO, CARLOS R., PHD (JSC-EA4) (NASA); CLOUDT, CHRIS R. (JSC-SX) (HEI); HADFIELD, CHRIS (JSC-CB) (CSA); Chris Lessmann; BOYKIN, CHRISTINE M. (JSC-MS2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA); CLEMENTS, DANIEL L. (JSC-NC) (GHG); BROWN, DAVID M. (JSC-CB) (NASA); MOYER, DAVID S. (JSC-MV5) (NASA); BRETZ, DAVID R. (JSC-SX) (HEI); David Rigby / MPS SSM (E-mail); HAYNES, DENA S. (JSC-EV) (NASA); PREVETT, DONALD E. (DON) (JSC-EP) (NASA); MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); Doug White; Douglas Powell (MAF); MAYER, FRED F. (JSC-NC) (SAIC); Gail Hargrove Boeing-Houston Imagery Scrn.; Greg Katnik; GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA); BYRNE, GREGORY J., PHD (JSC-SX) (NASA); WALTERS, JAMES B. (BRITT) (JSC-SM) (NASA); 'James Feeley' (E-mail); WALTERS, JAMES B. (BRITT) (JSC-SM) (NASA); JIMENEZ, JAVIER J. (JSC-EB) (LM); Jeff Goodmark (E-mail); RICHART, JENE A. (JSC-MS2) (NASA); LIN, JILL D. (JSC-MV5) (NASA); Jim Harder; 'John McKee' (E-mail); John Ventimiglia; DISLER, JONATHAN M. (JON) (JSC-SX) (LM); Jorge Rivera; KRAMER, JULIE A. (JSC-EA4) (NASA); Karen Alfaro (E-mail); BROWN, KENNETH L. (JSC-MV6) (NASA); CROSBY, KEVIN L. (JSC-SX) (LM); 'L Lohrli' (E-mail); Malcolm Glenn; ERMINGER, MARK D. (JSC-NC) (NASA); ERMINGER, MARK D. (JSC-NC) (NASA); HOLDERMAN, MARK L. (JSC-MS3) (NASA); IVINS, MARSHA S. (JSC-CB) (NASA); MARTINEZ, HUGO E. (JSC-NC) (GHG); ANDERSON, MICHAEL P. (JSC-CB) (NASA); SNYDER, MICHAEL W. (JSC-SX) (LM); Mike Cagle / Boeing Film Screen; Mike O'farrell; BERTSCH, P. J. (JEFF) (JSC-DM2) (NASA); Pam Madera (E-mail); DYE, PAUL F. (JSC-DA8) (NASA); PAYNE, ROBERT W. (JSC-SA13) (LM); 'Philip Kopfinger' (E-mail); Philip Peterson / Boeing Film Screen (E-mail); Philip Reid / Boeing Film Screen; SAGANTI, PREMKUMAR, PHD (JSC-SF) (LM); ADAMS, RANDALL W. (JSC-MA2) (NASA); SILVESTRI, RAYMOND T. (RAY) (JSC-DM4) (NASA); HUSBAND, RICK D. (JSC-CB) (NASA); Robbie Robinson; Robert Page; SCHARF, ROBERT (JSC-SX) (LM); Robert Speece; FRICKE, ROBERT W., JR (JSC-MV) (LM); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); WALLACE, RODNEY O. (ROD) (JSC-MS2) (NASA); Rohit Dhawan; CLAYTON, RONALD G. (RONNIE) (JSC-MS2) (NASA); GLANVILLE, ROY W. (JSC-NC) (NASA); Rudy Ramon; SA REP; Sara Brandenburg; Scott Otto; FRICK, STEPHEN N., CDR. (JSC-CB) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); Tom Rieckhoff; Tom Wilson; 'Treith' (E-mail)  
Subject: JSC STS-107 Launch Film Review Status

JSC STS-107 Launch Film Screening Status

JSC Image Science and Analysis Group Human Exploration Science Office /  
SX

The screening of the STS-107 long range tracking camera films is complete except for the viewing of camera film E204 which will be screened Sunday morning (1/19). Camera E212 provided an additional look at the Orbiter left wing at the time of the debris strike (described in the previous report on the video screening). No significant new information was learned from today's film screening.

Crew acquired down linked video imaging the External Tank (ET), probably the source of the debris that struck the Orbiter left wing, was reviewed this afternoon. Unfortunately the view is of the far side of the ET and provided no information as to the source of the debris object. A down linked view of

the Orbiter left wing upper surface from a payload bay camera did not  
image  
the suspected impact area.

Enhanced movie loops of the debris strike event have been placed on the  
web  
at the following address:

[http://sn-isag.jsc.nasa.gov/shuttleweb/mission\\_support/sts-107/launch\\_video/  
107launchvideo.shtml](http://sn-isag.jsc.nasa.gov/shuttleweb/mission_support/sts-107/launch_video/107launchvideo.shtml)

Screening of the remaining STS-107 launch films is expected to be  
completed  
Sunday afternoon and a report will be sent to distribution on Monday  
January  
20th.

Jon Disler / SX3-LM  
Chris Cloudt / SX3-HEI

**Michele Lewis**

---

**From:** Madera, Pamela L [pam.l.madera@usahq.unitedspacealliance.com]  
**Sent:** Monday, January 27, 2003 10:10 AM  
**To:** Madera, Pamela L; CURRY, DONALD M. (JSC-ES3) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); Nagle, Scott M; GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA); Jacobs, William A; 'Scott Christensen V (E-mail)'; 'Norman Ignacio (Nacho) (E-mail)'; CHAO, DENNIS; Stoner-1, Michael D; 'Carlos Ortiz (E-mail)'; 'Michael J Dunham (E-mail)'; Sebesta, Stephen P; CORONADO, DIANA; 'Craig Madden' (E-mail); Bell, Dan R.; Gordon, Michael P.; 'Paul A Parker (E-mail)'; ALEXANDER, ED; GAVERT, DONALD E; Harder, James R

**Subject:** FW: Thanks

Wanted to forward a note of thanks for a job well done - a direct reflection of your hard work and significant contributions! Please accept my thanks as well - an excellent job by all!

*Pam Madera*

Vehicle and Systems Analysis Subsystem Area Manager  
Phone: 281-282-4453

(I can receive a short alpha numeric page by addressing e-mail to:

-----Original Message-----

**From:** MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA) [mailto:donald.l.mccormack@nasa.gov]  
**Sent:** Friday, January 24, 2003 3:45 PM  
**To:** Madera, Pamela L  
**Cc:** 'White, Doug'; OUELLETTE, FRED A. (JSC-MV6) (NASA)  
**Subject:** Thanks

Pam,

I the rush this morning I failed to thank you for the fantastic job that you and your team did in pulling together the weight exceedence and tile damage assessments. So, thanks to you and your team, we appreciate it!!  
Don

## Michele Lewis

**From:** Salvador, Lincoln J. [LJSalvad@xch-bsco-06.ksc.nasa.gov]  
**Sent:** Thursday, December 12, 2002 4:45 PM  
**To:** HAMMERSCHMIDT, MARK M. (JSC-EG4) (NASA); EXT-Madera, Pamela L; Harder, James R; Blankinship, Kevin G; Tanita, Thomas T; EXT-Reed, Milton W; SILVESTRI, RAYMOND T. (RAY) (JSC-DM4) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); KRAMER, JULIE A. (JSC-EA4) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); Bob Reitz; Brian Bihari; Gavert, Donald E; MAY, DARRYL W. (JSC-MV2) (NASA); HERNANDEZ, FRANCISCO J. (JSC-EP) (NASA); SARAFIN, MICHAEL L. (JSC-DF6) (NASA); RUPPERT, JOHN P. (JSC-EG) (NASA); GRUBER, DAVID J. (JSC-DF611) (NASA); SCHOENBERG, RICHARD J. (JSC-EP4) (NASA)  
**Cc:** Salvador, Lincoln J.  
**Subject:** RE: Splinter Entry GNC Panel - Bodyflap Pictures

Just a clarification of these pictures, beacuse they do look terrible.

Pic 4763 is the only one of concern. It is of the planet gear interior to the actuator.

The other three pics are of the input shaft splines which are exterior to the actuator, and after the corrosion and flaking nickel plating was removed the shaft is acceptable for reuse.

There was no appreciable parent material loss in the splines. Furthermore all splines carry the load (distributed), while a gear tooth or 2 carries the load.

The planet gear tooth corrosion is more significant from a failure perspective.

## Link Salvador

Boeing Sub-System Manager  
 Mechanisms, Latches, MPM  
 NSLD, Cape Canaveral, FL.  
 321.799.6836 (voice)

-----Original Message-----

**From:** Mark M Hammerschmidt [mailto:mark.m.hammerschmidt@nasa.gov]  
**Sent:** Thursday, December 12, 2002 12:30 PM  
**To:** Pam Madera; Jim Harder; Kevin Blankinship; Thomas Tanita; Milt Reed; Ramond Silvestri; STEPHEN M. STEVE JSC EG3 NASA DERRY; ALAN R. RODNEY JSC ES2 NASA ROCHA; JULIE A. JSC EA4 NASA KRAMER; VINCENT M. JSC EG NASA LEVY; Bob Reitz; Brian Bihari; Don Gavert; DARRYL W. JSC MV2 NASA MAY; FRANCISCO J. JSC EP NASA HERNANDEZ; MICHAEL SARAFIN; JOHN P. JSC EG NASA RUPPERT; DAVID GRUBER; RICHARD SCHOENBERG  
**Cc:** Lincoln J. Salvador  
**Subject:** Splinter Entry GNC Panel - Bodyflap Pictures

FYI. Here's some of the pictures of the bodyflap corrosion.

mark

**Michele Lewis**

---

**From:** Madera, Pamela L [pam.l.madera@usahq.unitedspacealliance.com]  
**Sent:** Thursday, December 12, 2002 12:17 PM  
**To:** DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Cc:** HAMMERSCHMIDT, MARK M. (JSC-EG4) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA)  
**Subject:** RE: Splinter Entry GNC Panel

FYI - I have forwarded this notice to Olman Carvejal, Dennis Chao, and Nacho Ignacio.

*Pam Madera*

Vehicle and Systems Analysis Subsystem Area Manager  
 Phone: 281-282-4453

(I can receive a short alpha numeric page by addressing e-mail to:

-----Original Message-----

**From:** Mark M Hammerschmidt [mailto:mark.m.hammerschmidt@nasa.gov]  
**Sent:** Thursday, December 12, 2002 11:16 AM  
**To:** Pam Madera; Jim Harder; Kevin Blankinship; Thomas Tanita; Milt Reed; Ramond Silvestri; STEPHEN M. STEVE JSC EG3 NASA DERRY; ALAN R. RODNEY JSC ES2 NASA ROCHA; JULIE A. JSC EA4 NASA KRAMER; VINCENT M. JSC EG NASA LEVY; Bob Reitz; Brian Bihari; Don Gavert; DARRYL W. JSC MV2 NASA MAY; FRANCISCO J. JSC EP NASA HERNANDEZ; MICHAEL SARAFIN; JOHN P. JSC EG NASA RUPPERT; DAVID GRUBER; RICHARD SCHOENBERG  
**Cc:** Lincoln J. Salvador  
**Subject:** Splinter Entry GNC Panel

This is a reminder that we will have a one hour splinter Entry GNC Panel this afternoon to get a quick assessment of potential impacts to flight dynamics if a bodyflap becomes stuck.

Since all of our main conference rooms will be tied-up for the annual Christmas lunches, we will be meeting in a smaller (about 20 people) conference room located on the second floor in building 16A. The room doesn't have a projector so if you have anything to present, please bring sufficient copies. Don, I will call you at

Date : Thursday, December 12  
 Time : 2:00 PM to 3:00 PM  
 Place : Bldg 16A, Rm 2124

**Discussion Items:**

- Stuck bodyflap scenarios
- Range of onorbit checkout sweep

- Range of nominal trajectory dispersions
- Worst Case
  - Forward CG: Bodyflap stuck full down
  - Aft CG: Bodyflap stuck full up
- Configurations
  - Nominal
  - Dispersions (aero, CG)
  - CG shifts due to propellant dumps
- Trajectories
  - NEOM
  - Intact aborts (RTLS, TAL, AOA)
  - Contingency aborts
- Effects of elevator trim change
  - Stability
  - Hinge moments
  - Thermal
  - Loads
- Tailscape
- Preliminary SES / SDAP results
- What about the Rudder / Speedbrake?

Note: if you're having trouble finding the meeting room and all of the rooms around you have only 3 digit room numbers, you're still in building 16, not 16A.

--

Mark Hammerschmidt  
EG4/Branch Chief  
(281) 483-8302

## Michele Lewis

---

**From:** LEVY, VINCENT M. (JSC-EG) (NASA)  
**Sent:** Thursday, December 12, 2002 11:31 AM  
**To:** DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA)  
**Subject:** RE: STS-107 Quick Look Summary - PLEASE RESPOND ASAP!!!!

It's an issue, if you find impacts. As of today it's being evaluated and needs to be address to EA management. They will make the final decision on whether it's an issues or not. Unless we come with convincing data that it is.

*Vincent M. Levy*

EG/Aeroscience & Flight Mechanics  
Shuttle Division Chief Engineer  
281-483-0874 (w)

281-483-1245 (fax)

-----Original Message-----

**From:** DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA)  
**Sent:** Wednesday, December 11, 2002 6:40 PM  
**To:** LEVY, VINCENT M. (JSC-EG) (NASA)  
**Subject:** RE: STS-107 Quick Look Summary - PLEASE RESPOND ASAP!!!!

Is this a 107 issue?

-----Original Message-----

**From:** LEVY, VINCENT M. (JSC-EG) (NASA)  
**Sent:** Wednesday, December 11, 2002 5:25 PM  
**To:** SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)  
**Cc:** HAMMERSCHMIDT, MARK M. (JSC-EG4) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA); RUPPERT, JOHN P. (JSC-EG) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Subject:** RE: STS-107 Quick Look Summary - PLEASE RESPOND ASAP!!!!

EG Topics:

The GNC Technical Panel and Entry Aerothermo group will provide results on assessment to entry flight control impacts for different Body Flap settings in the event of a Body Flap actuator Jam/failure.

*Vincent M. Levy*

EG/Aeroscience & Flight Mechanics  
Shuttle Division Chief Engineer  
281-483-0874 (w)

281-483-1245 (fax)

-----Original Message-----

**From:** SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)  
**Sent:** Wednesday, December 11, 2002 2:06 PM  
**To:** DINSMORE, CRAIG E. (JSC-EC5) (NASA); CHHIPWADIA, KETAN S. (K.C.) (JSC-EC) (NASA); BRANCH, GLEN (JSC-EB) (NASA); STEPHENSON, DAVID A. (JSC-EB) (NASA); WITTSCHE, BARRY C. (JSC-EA4) (NASA); BENAL, LEO C. (JSC-EA) (NASA); RODRIGUEZ, HECTOR I. (JSC-EA4) (NASA); SAIZ, JOHN R. (JSC-EB) (NASA); WETTERSTROEM, ALBERT (JSC-EB) (NASA); ALBRIGHT, JOHN D. (JSC-EP4) (NASA); DUNN, KEVIN W. (JSC-EV) (NASA); GRUSH, GENE R. (JSC-EP111) (NASA); JACOBS, JEREMY B. (JSC-ES4) (NASA); KAUPP, HENRY J. (JSC-ER3) (NASA); KRAMER, JULIE A. (JSC-EA4) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); METCALF, JORDAN L. (JSC-EC6) (NASA); PHAM, CHAU H. (JSC-EC6) (NASA); PREVETT, DONALD E. (DON) (JSC-EP) (NASA); PRUETT, WILLIAM R. (JSC-EV) (NASA); ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); ROMERO, DENISE M. (JSC-EV) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); SHACK, PAUL E. (JSC-EA42) (NASA); THIBODEAU, JOSEPH R. (JOE) (JSC-EG) (NASA); WAGNER, HOWARD A., PHD (JSC-EP) (NASA); WILSON, SUE U. (JSC-EA) (NASA)  
**Cc:** SHACK, PAUL E. (JSC-EA42) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); WILSON, SUE U. (JSC-EA) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)  
**Subject:** STS-107 Quick Look Summary - PLEASE RESPOND ASAP!!!!

DCEs:

**PLEASE LIMIT DISTRIBUTION OF THIS EMAIL DUE TO STS-107 LAUNCH INFO ENCLOSED**

Here is what I have so far for our STS-107 Quick Look Summary for Frank Benz/Lauri Hansen. I am missing inputs from EB, EC-ECLS, EG, ES, and EV. Please review the package and respond ASAP. I had hoped to finish this today since I will be out tomorrow and perhaps Friday due to circumstances beyond my control! This goes to EA management on Monday, Dec 16th.

Thanks,  
Joyce

<< File: STS-107 Benz Quick Look summary.ppt >>

**Joyce M. Seriale-Grush**  
**Shuttle Engineering Office/EA42**  
**Phone: 281-483-4542**  
**Fax: 281-483-2965**

**Michele Lewis**

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Tuesday, January 21, 2003 7:40 AM  
**To:** 'Brolliar, Steve S'  
**Cc:** 'Patel, Vipul B'; 'Patel, Arvind C'; 'Wyckoff, Mike G'; 'Mike Murphy (MSFC) (E-mail)'; 'Kendall, Kristin L'; RICHART, JENE A. (JSC-MS2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA); WALLACE, RODNEY O. (ROD) (JSC-MS2) (NASA)  
**Subject:** RE: ETA Ring Analysis

Steve,

I hope you or someone from SRB Project can present to Loads Panel this week (Wed., Thur., or Fri.) or, at the latest, Monday, Jan. 27, if you really need substantially more time. I am particularly concerned about not knowing the margin numbers beyond STS-107 lift-off (i.e., roll maneuver, hi-q regions, etc.) and not presenting such to SSP launch managers at the midnight Tanking meeting.

**Rodney Rocha**  
**Structural Engineering Division (ES-SED)**

- ES Div. Chief Engineer (Space Shuttle DCE)
- Chair, Space Shuttle Loads & Dynamics Panel

**Mail Code ES2    Phone 281-483-8889**

**Michele Lewis**

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Thursday, January 30, 2003 12:36 PM  
**To:** HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA)  
**Subject:** RE: SRB Neg. Margin Issue, Information for Frank Benz

Dave,  
The SRB project folks (Mike Murphy/SRM, Steve Broliar/SRB/USA) say that internal pressure in the case is a big component--about 64% of the total load on the aft ring structure. Such pressure is a function of the bulk propellant temperature and they get this model from Thiokol. I want them to verify they are using a test-verified model for this. Cool or cold day launches may help them now, but as the seasons approach summer, this mitigation may go away.

At Monday's Load Panel, SRB present to us more specifics on their critical load cases, both lift-off and ascent high-q.

**Rodney Rocha**  
**Structural Engineering Division (ES-SED)**  
• ES Div. Chief Engineer (Space Shuttle DCE)  
• Chair, Space Shuttle Loads & Dynamics Panel  
Mail Code ES2 Phone 281-483-8889

**Michele Lewis**

---

**From:** MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA)  
**Sent:** Friday, January 24, 2003 1:10 PM  
**To:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Subject:** RE: STS-107 CHIT STS0006

Thanks Rodney.

-----Original Message-----

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Friday, January 24, 2003 11:12 AM  
**To:** MCCORMACK, DONALD L. (DON) (JSC-MV6) (NASA); OUELLETTE, FRED A. (JSC-MV6) (NASA)  
**Subject:** FW: STS-107 CHIT STS0006

This email trail below is to verify that Structures Work Group evaluated the STS-107 expected landing weight exceedance and has no issues or concerns.

**Rodney Rocha**  
**Structural Engineering Division (ES-SED)**  
7 ES Div. Chief Engineer (Space Shuttle DCE)  
7 Chair, Space Shuttle Loads & Dynamics Panel

**Mail Code ES2 Phone 281-483-8889**

-----Original Message-----

**From:** Bruno, Erica E [mailto:Erica.E.Bruno@USAHQ.UnitedSpaceAlliance.com]  
**Sent:** Friday, January 24, 2003 8:38 AM  
**To:** RICHART, JENE A. (JSC-MS2) (NASA); FOGT, VINCENT A. (JSC-ES2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA)  
**Cc:** Fox, Nelson P; ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Subject:** RE: STS-107 CHIT STS0006

Yes.

Erica

-----Original Message-----

**From:** RICHART, JENE A. (JSC-MS2) (NASA) [mailto:jene.a.richart@nasa.gov]  
**Sent:** Friday, January 24, 2003 8:13 AM  
**To:** 'Bruno, Erica E'; FOGT, VINCENT A. (JSC-ES2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA)  
**Cc:** Fox, Nelson P; ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Subject:** RE: STS-107 CHIT STS0006  
**Importance:** High

I Concur. Is there a typo in "The OV-103 model was approved to use for OV-103 with no modifications to account for the weight differences.", shouldn't the 2nd 103 be 102?

-----Original Message-----

**From:** Bruno, Erica E [mailto:Erica.E.Bruno@USAHQ.UnitedSpaceAlliance.com]  
**Sent:** Friday, January 24, 2003 8:02 AM  
**To:** FOGT, VINCENT A. (JSC-ES2) (NASA); RICHART, JENE A. (JSC-MS2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA)  
**Cc:** Fox, Nelson P; ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Subject:** RE: STS-107 CHIT STS0006

Thanks. I also noticed one Orbiter load ratio near one but I also saw that it was case and time uncorrelated and it was from the first VLA cycle with the 1.1 MUF on it.

Erica

-----Original Message-----

**From:** FOGT, VINCENT A. (JSC-ES2) (NASA) [mailto:vincent.a.fogt@nasa.gov]

**Sent:** Friday, January 24, 2003 7:59 AM

**To:** 'Bruno, Erica E'; RICHART, JENE A. (JSC-MS2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA)

**Cc:** Fox, Nelson P; ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)

**Subject:** RE: STS-107 CHIT STS0006

Erica - This looks reasonable. Also, I scanned through the VLA-3 FAR charts and we have good margins for landing. There were some orbiter load ratios near 1, but Boeing also provided the stress margins in these cases, which were high (min .80). FREESTAR and SPACEHAB margins were either high or the VLA loads are significantly enveloped by design. The SPACEHAB tunnel loads were higher than design, but dominated by liftoff (and had positive margins, of course). I have no information on EDO or the TAA, which is orbiter H/W.

Vince

-----Original Message-----

**From:** Bruno, Erica E

[mailto:Erica.E.Bruno@USAHQ.UnitedSpaceAlliance.com]

**Sent:** Thursday, January 23, 2003 4:51 PM

**To:** RICHART, JENE A. (JSC-MS2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA); FOGT, VINCENT A. (JSC-ES2) (NASA)

**Cc:** Fox, Nelson P

**Subject:** STS-107 CHIT STS0006

I received this CHIT request information on what type of analysis is required if the Orbiter return weight violates the Orbiter Landing Weight Flight Rule of 233,000 lbs. for a 39 deg. inclination orbit. The CHIT also requests how long the analysis would take and to be prepared to proceed with the analysis by Friday morning, assuming a 234,000 lbs Orbiter with worst case CG. The increase in the landing weight is primarily due to excess cryogenics being returned as well as ARCS propellant.

RESPONSE: No further analysis is necessary from Cargo Integration for the heavier landing Orbiter.

RATIONALE: STS-107 is being flown on OV-102 which is generally heavier than OV-103. Our math models are developed based on the OV-103 weights and the comparison this summer between OV-102 and OV-103 shows a weight difference of 6,000 to 9,000 pounds difference between the two. The OV-103 model was approved to use for OV-103 with no modifications to account for the weight differences. We also ran two normal landing cases at 9.6 fps - one with the EDO empty (total of about 3,000 lbs) and EDO 1/2 empty (about 5,000 lbs). Both cases were shown good for landing. I believe that the current STS-107 landing configuration will be very similar to the EDO 1/2 empty case.

If you agree with this, please let me know by 8:15 tomorrow morning.

ERica

*Erica E. Bruno* - United Space Alliance

Structures Project Lead, Cargo Analysis & Hardware Integration

Phone: 281-280-6945 Fax: 281-212-6045

Mail Code: USH-700D

Erica.E.Bruno@usahq.unitedspacealliance.com

Visit the SSP Integration Structures home page at:

<http://sspweb.jsc.nasa.gov/webdata/mshome/struct/st-index.htm>

**Michele Lewis**

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Wednesday, January 22, 2003 10:22 AM  
**To:** 'Madera, Pamela L'; CURRY, DONALD M. (JSC-ES3) (NASA); LEVY, VINCENT M. (JSC-EG) (NASA); KOWAL, T. J. (JOHN) (JSC-ES3) (NASA); DERRY, STEPHEN M. (STEVE) (JSC-EG3) (NASA)  
**Cc:** 'Scott Christensen V (E-mail)'; 'Norman Ignacio (Nacho) (E-mail)'; CHAO, DENNIS; Stoner-1, Michael D; 'Carlos Ortiz (E-mail)'; 'Michael J Dunham (E-mail)'; Sebesta, Stephen P; CORONADO, DIANA; 'Craig Madden' (E-mail); Bell, Dan R.; Gordon, Michael P.; Paul A Parker (E-mail)  
**Subject:** RE: STS-107 Debris Analysis Team Plans

I have conference room 221 in JSC Building 13 available for today's 1:00 PM telecon. Located on second floor.

**Rodney Rocha**

**Structural Engineering Division (ES-SED)**

- ES Div. Chief Engineer (Space Shuttle DCE)
- Chair, Space Shuttle Loads & Dynamics Panel

**Mail Code ES2 Phone 281-483-8889**

**Michele Lewis**

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Thursday, January 23, 2003 10:24 PM  
**To:** 'Bruno, Erica E'; FOGT, VINCENT A. (JSC-ES2) (NASA); RICHART, JENE A. (JSC-MS2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA); TAYLOR, DENEEN M. (JSC-ES2) (NASA)  
**Cc:** SHACK, PAUL E. (JSC-EA42) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)  
**Subject:** RE: STS-107 Revised Landing Weight

Refer to the presentation from Orbiter going to the MER on Friday, Jan 24, identifying impacts to Orbiter due to the heavier weight expected at STS-107 landing. Has the Structure Working Group (SWG) made a decision on a new assessment or not regarding Orb/payload interface loads and relative deflections? If not to be done, what is rationale? Thanks.

**Rodney Rocha**

- **Division Chief Engineer (DCE), ES-Structural Engineering Division**
- **Chair, Space Shuttle Loads & Dynamics Panel**
- **Mail Code ES2      x38889**

-----Original Message-----

**From:** Bruno, Erica E [mailto:Erica.E.Bruno@USAHQ.UnitedSpaceAlliance.com]  
**Sent:** Thursday, January 23, 2003 7:35 AM  
**To:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); FOGT, VINCENT A. (JSC-ES2) (NASA); RICHART, JENE A. (JSC-MS2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA); TAYLOR, DENEEN M. (JSC-ES2) (NASA)  
**Subject:** RE: STS-107 Revised Landing Weight  
**Importance:** High

This may affect the landing models however, we in cargo have always used nominal EOM propellant loadings. This weight is above the weight limit of the forcing functions we have used to date for STS-107. I look to the SWG to make a call if the margins of safety need to be reviewed for the Cargo Elements to cover this higher return weight case.

Erica

-----Original Message-----

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA) [mailto:alan.r.rocha@nasa.gov]  
**Sent:** Wednesday, January 22, 2003 5:56 PM  
**To:** FOGT, VINCENT A. (JSC-ES2) (NASA); RICHART, JENE A. (JSC-MS2) (NASA); LARSEN, CURTIS E. (JSC-MS2) (NASA); 'erica.e.bruno@usahq.unitedspacealliance.com'; TAYLOR, DENEEN M. (JSC-ES2) (NASA)  
**Subject:** FW: STS-107 Revised Landing Weight

Does this possibility of STS-107 Orbiter landing weight exceedance cause any impacts to the Orbiter/cargo interface landing loads? Thanks.

**Rodney Rocha**  
**Structural Engineering Division (ES-SED)**

- **ES Div. Chief Engineer (Space Shuttle DCE)**
- **Chair, Space Shuttle Loads & Dynamics Panel**

---

Mail Code ES2   Phone 281-483-8889

-----Original Message-----

**From:** Madera, Pamela L [mailto:pam.l.madera@usahq.unitedspacealliance.com]  
**Sent:** Wednesday, January 22, 2003 5:49 PM  
**To:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Subject:** FW: STS-107 Revised Landing Weight

Rodney,

The action that was given to our area from the MER is to say what would be required to waive the 233000 lb downweight limit and to discuss what downweight exceedances have occurred in the past. The weight that I was informally told was about 233,700 lbs. No work is turned on right now - they just want to know what would be required.

Pam Madera

Vehicle and Systems Analysis Subsystem Area Manager

Phone: 281-282-4453

-----Original Message-----

**From:** Davies, Tim [mailto:tim.davies@boeing.com]  
**Sent:** Wednesday, January 22, 2003 1:25 PM  
**To:** Hoffman, Thomas L; Heinol, Chip C; Goodmark, Jeffrey A; Coronado, Diana; EXT-Chang, Yuan-chyau ; EXT-Hong, Andrew E; Reynolds, Daniel F; Gonzales, Guadalupe; Tran, John Q; Belknap, Shannon; Norman, David; EXT-Madera, Pamela L; Christensen, Scott V; Alexander, Ed C; Carvajal, Olman; Norman, Ignacio; Chao, Dennis C; Russell, David J; Tidwell, Stephen D; Andrews, Bill; EXT-Thomas, Samuel J  
**Subject:** STS-107 Revised Landing Weight

All,

Attached is the flight note which FDO released updating the predicted landing weight. I have not received revised tire limits for these predictions. The preflight NEOM tire limits of 335 psia (11degF) are based on a 232,600 lb. Note that the 657 lb violation is for the downweight limit (233,000 lb); not the same as the limit for the NEOM tire prediction. The predicted landing weights will fluctuate over the next few days so the flight director has asked that no additional analysis be performed until landing -4 days.

I will provide updates as they become available.

<<FOFN146.pdf>>

Tim Davies

Boeing - Orbiter TCS

281.483.3919 (MER)

**Michele Lewis**

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Tuesday, January 21, 2003 7:53 PM  
**To:** 'Stephens, John L'  
**Cc:** 'matt.vogel@lmco.com'  
**Subject:** RE: STS-107 SRB HOLD DOWN POST LOADS

Thank you. Some of the Loads Panel membership is already familiar with hold-down loads derivation from strain, but I am also wanting to know about the anomalous spikes and what they might mean. An overview or refresher may help for those unfamiliar or new to Loads Panel. Have you verified no STS-107 stud-hang-up for certain yet? What is the recovery plan if a strain gage is damaged or redundancy is lost at a post?

Please contact Matt Vogel/Lockheed-Martin to schedule the topic for Monday. Thanks again.

Rodney Rocha  
Structural Engineering Division (ES-SED)  
\* ES Div. Chief Engineer (Space Shuttle DCE)  
\* Chair, Space Shuttle Loads & Dynamics Panel  
Mail Code ES2 Phone 281-483-8889

**Michele Lewis**

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Wednesday, January 22, 2003 10:21 AM  
**To:** 'Prabhakar, Ashok '  
**Subject:** RE: STS-107 wing strike by ET insulation

Ash,

Can you please join our telecon today at 1:00 PM CST? The team apparently is talking to ET Project at KSC, but they did not mention Michoud at our first telecon yesterday. We want to assure ourselves that we are using the right material properties (mass density, etc.) for the insulation and any unique values if they do not originate from the bipod area. There may be other ET related questions come up.

Thanks.

**Rodney Rocha**  
**Structural Engineering Division (ES-SED)**

- ES Div. Chief Engineer (Space Shuttle DCE)
- Chair, Space Shuttle Loads & Dynamics Panel

**Mail Code ES2 Phone 281-483-8889**

## **Michele Lewis**

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Wednesday, January 29, 2003 3:07 PM  
**To:** 'Prabhakar, Ashok '  
**Subject:** Request for ET Model

Ash,  
Systems Integration CFD work is planned to continue beyond STS-107's landing so as to understand and reconstruct the ET debris insulation impact on the Orbiter wing underside. This effort, combined with the actual measurements of wing TPS damage, would greatly help us to calibrate our damage prediction models.

I understand there is a ET CAD model available from your project and you have already been in communication with Mr. Ray Gomez of the Aero-Thermal Panel (JSC/USA/Boeing). I am requesting that you provide us with such a model. This can be coordinated and delivered to Mr Gomez. Thank you, Ash.



ET geometry  
quest and STS-107

**Rodney Rocha**  
**Structural Engineering Division (ES-SED)**  
• ES Div. Chief Engineer (Space Shuttle DCE)  
• Chair, Space Shuttle Loads & Dynamics Panel  
Mail Code ES2 Phone 281-483-8889

## Michele Lewis

---

**From:** GOMEZ, REYNALDO J. (RAY) (JSC-EG3) (NASA)  
**Sent:** Wednesday, January 29, 2003 2:48 PM  
**To:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Subject:** ET geometry request and STS-107 debris

Rodney,

I would appreciate it if you could give Ashok Prabhakar the go ahead to release an External Tank CAD model to me. He has indicated that the file is ready to send but he is awaiting approval from you before he can release it to me. I would like to get a head start on the post STS-107 analysis that will probably require us to take another look at the External Tank protuberance airloads.

Based on the work done to support this STS-107 debris impact assessment, the Crater code sounds like it could use some updating and some additional validation. Don Curry brought up the hypervelocity impact codes that SN uses for on-orbit debris and Eric Christensen has indicated that their codes are applicable to tile impacts at these velocities. These codes along with some additional testing could probably be used to updated the Crater code so that it produces more realistic results. If there is any way that I can help support these improvements let me know.

Ray

---

Reynaldo J. Gomez	Aeroscience and Flight Mechanics Div.
Mail Code EG3	phone: 281-483-6108
NASA Johnson Space Center	fax: 281-244-5256
Houston, TX 77058	e-mail: reynaldo.j.gomez@nasa.gov

**Michele Lewis**

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Wednesday, January 22, 2003 6:15 PM  
**To:** SHACK, PAUL E. (JSC-EA42) (NASA)  
**Subject:** RE: STS-107 Wing Debris Impact, Request for Outside Photo-Imaging Help

Paul,  
Can you tell us more on Roe's negative answer? Is he and the SSP waiting on our analysis results first (Friday to the MMT) or what? What is Frank's position?

**Rodney Rocha**  
**Structural Engineering Division (ES-SED)**  
• ES Div. Chief Engineer (Space Shuttle DCE)  
• Chair, Space Shuttle Loads & Dynamics Panel  
**Mail Code ES2 Phone 281-483-8889**

## Michele Lewis

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Tuesday, January 21, 2003 5:41 PM  
**To:** SHACK, PAUL E. (JSC-EA42) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA); MILLER, GLENN J. (JSC-EA) (NASA)  
**Cc:** SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); ROGERS, JOSEPH E. (JOE) (JSC-ES2) (NASA); GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA)  
**Subject:** STS-107 Wing Debris Impact, Request for Outside Photo-Imaging Help

Paul and Dave,

The meeting participants (Boeing, USA, NASA ES2 and ES3, KSC) all agreed we will always have big uncertainties in any transport/trajectory analyses and applicability/extrapolation of the old Arc-Jet test data until we get definitive, better, clearer photos of the wing and body underside. Without better images it will be very difficult to even bound the problem and initialize thermal, trajectory, and structural analyses. Their answers may have a wide spread ranging from acceptable to not-acceptable to horrible, and no way to reduce uncertainty. Thus, giving MOD options for entry will be very difficult.\*

**Can we petition (beg) for outside agency assistance?** We are asking for Frank Benz with Ralph Roe or Ron Dittmore to ask for such. Some of the old timers here remember we got such help in the early 1980's when we had missing tile concerns.

\*Despite some nay-sayers, there are some options for the team to talk about: On-orbit thermal conditioning for the major structure (but is in contradiction with tire pressure temp. cold limits), limiting high cross-range de-orbit entries, constraining right or left had turns during the Heading Alignment Circle (only if there is struc. damage to the RCC panels to the extent it affects flight control).

**Rodney Rocha**

Structural Engineering Division (ES-SED)

ES Div. Chief Engineer (Space Shuttle DCE)

- Chair, Space Shuttle Loads & Dynamics Panel

Mail Code ES2 Phone 281-483-8889

## Michele Lewis

---

**From:** SHACK, PAUL E. (JSC-EA42) (NASA)  
**Sent:** Wednesday, January 22, 2003 12:45 PM  
**To:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA); MILLER, GLENN J. (JSC-EA) (NASA)  
**Cc:** SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); ROGERS, JOSEPH E. (JOE) (JSC-ES2) (NASA); GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA)  
**Subject:** RE: STS-107 Wing Debris Impact, Request for Outside Photo-Imaging Help

FYI - According to the MER, Ralph Roe has told the program that Orbiter is not requesting any outside imaging help

-----Original Message-----

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Tuesday, January 21, 2003 4:41 PM  
**To:** SHACK, PAUL E. (JSC-EA42) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA); MILLER, GLENN J. (JSC-EA) (NASA)  
**Cc:** SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA); ROGERS, JOSEPH E. (JOE) (JSC-ES2) (NASA); GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA)  
**Subject:** STS-107 Wing Debris Impact, Request for Outside Photo-Imaging Help

Paul and Dave,

The meeting participants (Boeing, USA, NASA ES2 and ES3, KSC) all agreed we will always have big uncertainties in any transport/trajectory analyses and applicability/extrapolation of the old Arc-Jet test data until we get definitive, better, clearer photos of the wing and body underside. Without better images it will be very difficult to even bound the problem and initialize thermal, trajectory, and structural analyses. Their answers may have a wide spread ranging from acceptable to not-acceptable to horrible, and no way to reduce uncertainty. Thus, giving MOD options for entry will be very difficult.\*

**Can we petition (beg) for outside agency assistance?** We are asking for Frank Benz with Ralph Roe or Ron Dittmore to ask for such. Some of the old timers here remember we got such help in the early 1980's when we had missing tile concerns.

\*Despite some nay-sayers, there are some options for the team to talk about: On-orbit thermal conditioning for the major structure (but is in contradiction with tire pressure temp. cold limits), limiting high cross-range de-orbit entries, constraining right or left had turns during the Heading Alignment Circle (only if there is struc. damage to the RCC panels to the extent it affects flight control).

**Rodney Rocha**

**Structural Engineering Division (ES-SED)**

- ES Div. Chief Engineer (Space Shuttle DCE)
- Chair, Space Shuttle Loads & Dynamics Panel

**Mail Code ES2 Phone 281-483-8889**

## Michele Lewis

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Wednesday, January 29, 2003 4:13 PM  
**To:** GOERNER, LAURA (JSC-EA) (NASA)  
**Cc:** SHACK, PAUL E. (JSC-EA42) (NASA); HAMILTON, DAVID A. (DAVE) (JSC-EA) (NASA); PREVETT, DONALD E. (DON) (JSC-EP) (NASA); ROGERS, JOSEPH E. (JOE) (JSC-ES2) (NASA); GALBREATH, GREGORY F. (GREG) (JSC-ES2) (NASA); JACOBS, JEREMY B. (JSC-ES4) (NASA); SERIALE-GRUSH, JOYCE M. (JSC-EA) (NASA)  
**Subject:** SRB Neg. Margin Issue, Information for Frank Benz

Laura,



sts107\_114\_S  
strut loads\_LP\_

As per Frank's request this morning, please provide this information to him on this subject. Thank you.

### SUMMARY

- Negative margins (equivalent to factor-of-safety reduction to  $FS = 1.25$ ; requirement is  $FS = 1.4$ ) are real and based on recent materials properties testing. May be caused by improper heat treatment. Affects struc. margins calculated against lift-off and ascent flight design loads and struc. life remaining in hardware.
- Aft ring structure is the critical structure where attach struts are mounted between SRB and ET. See picture in attached briefing.
- SRB Project has requested MS/Systems Integration (through the EA Shuttle Loads & Dynamics Panel) to provide flight specific lift-off limit loads: i.e., based on unique mass & stiffness properties, cargo manifest/coupled dynamics, and bulk propellant temperature from Thiokol (affects internal case pressure contribution to loads).
- Roll maneuver is not a critical case.
- Ascent (Hi-Q= high dynamic pressure) loads needed too, but there may be mitigation here based on the way we protect all load indicators for Orbiter and ET. We are looking at this. There some task options (ascent only) which lead to reduction in day-of-launch probabilities, but we are trying to avoid these if possible since SSP probably would consider this only as last resort.
- Such flight specific limit loads are definitely needed for STS-114 and maybe several more flights. Loads Panel hears their specific requests and status at the Feb. 3 Loads Panel.



FW: SHUTTLE SA01714.pdf  
EVAL S091496

Rodney Rocha

Structural Engineering Division (ES-SED)

- ES Div. Chief Engineer (Space Shuttle DCE)
- Chair, Space Shuttle Loads & Dynamics Panel

Mail Code ES2 Phone 281-483-8889

**Michele Lewis**

---

**From:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Sent:** Tuesday, January 28, 2003 11:47 PM  
**To:** BOUQUET, LENA L. (JSC-ES2) (MRI)  
**Cc:** JACOBS, JEREMY B. (JSC-ES4) (NASA); PREVETT, DONALD E. (DON) (JSC-EP) (NASA)  
**Subject:** FW: SHUTTLE EVAL S091496

Lena,  
I approve CR S091496 with comments. See the attached eval. form below for my eval. and remarks.  
Attention: Don Prevett: Of interest to you and SSEIG.

**Rodney Rocha (ES2) x38889**

- **Division Shuttle Chief Engineer (DCE), ES-Structural Engineering**
- **Chair, Space Shuttle Loads & Dynamics Panel**

-----Original Message-----

**From:** BOUQUET, LENA L. (JSC-ES2) (MRI)  
**Sent:** Wednesday, January 22, 2003 1:14 PM  
**To:** ROCHA, ALAN R. (RODNEY) (JSC-ES2) (NASA)  
**Subject:** FW: SHUTTLE EVAL S091496

Rodney,  
Evaluations for S091496 are due by 2/4/03.  
Thanks,  
Lena

-----Original Message-----

**From:** ENGDahl, SARA (JSC-MG) (USA)  
**Sent:** Tuesday, January 21, 2003 2:18 PM  
**To:** CM Receipt Desk (ES)  
**Subject:** SHUTTLE EVAL S091496

Attn: R. Rocha

CR S091496 - SRB ETA RING STRUCTURE FACTOR OF SAFETY is being submitted for evaluation. Please provide your input on the form NLT 2/4. Thanks!



S091496.pdf Eval Form.doc

**Sara Engdahl**  
**EA-CRG/Payload OMRS (POG) Directive Focal Point**  
**281.483.6796**  
**sara.engdahl1@jsc.nasa.gov**

NOT ON  
Masterlist



---

**STS-107/114 SRB Mission Specific Loads  
in Support of ET/SRB Aft Attach Ring  
Material Properties Issue**

Loads Panel  
1/27/03

Subcontract: 1970483303  
WBS: 1.2.2.1/20037  
PDRD: SC004

Lee Wilson (281) 226-5539  
Ed Dougherty (281) 226-5577  
Ramon Perez (714) 372-6755



# Agenda

---

- Objectives
- Background
- Liftoff
  - Results (STS-107, STS-114)
  - Summary/Forward Plan
- High-Q
  - Results (STS-107, SLWT Operational High-Q)
  - Summary/Forward Plan
- Back-up



# Objectives

---

- STS-107 mission specific ET/SRB strut and interface load results for Liftoff and High-Q flight regimes
- STS-114 mission specific ET/SRB strut load results for Liftoff flight regime
- Schedule for future results



## Background

---

- **ET/SRB attach ring material properties**
  - Strength testing for ET/SRB attach (ETA) ring determined that material strength properties were lower than required in localized areas
  - Design load case analysis using worst-case material properties resulted in a minimum factor of safety of 1.25. NSTS 07700 requires a minimum safety factor of 1.4 for Space Shuttle general structure.
- **In order to gain some potential relief, the SRB Element requested mission specific ET/SRB strut and interface loads for STS-107**
- **Request for mission specific ET/SRB strut and interface loads repeated for STS-114 and STS-115**
- **No Liftoff SRB indicator exceedances of baseline limits for STS-107 or STS-114**
- **No High-Q SRB indicator exceedances of baseline limits for STS-107 (STS-114 is generically certified)**

# Liftoff Results – STS-107

## ■ Liftoff Flight Regime

### - Methodology

- Results from STS-107 Liftoff FMA (presented to Loads Panel 6/10/02)
- Load indicator envelope table used to determine max/min values for the ET/SRB aft attach struts (P8/11, P9/12, P10/13) and time of occurrence
- Determined time consistent complement of strut loads

### - Results

	Maximized Strut Indicators					
	P8/11+ (max 165.67)	P8/11- (max -197.07)	P9/12+ (max 207.79)	P9/12- (max -67.62)	P10/13+ (max 68.57)	P10/13- (max -150.65)
P8[kips]			-24.94	-32.01	44.50	-63.87
P9[kips]	15.56	68.61			43.40	62.12
P10[kips]	-42.86	-96.05	-40.11	-75.76		
Time[s]*	7.175	7.061	6.895	7.751	8.169	8.288
Case	LO013	LO347	LO102	LO148	LO672	LO146

\* After SSME ignition

### - Documented

- "STS-107 SRB/ET Aft Attach Ring Liftoff Load Environments"; 03MA0029, J. A. Kaminsky to G. P. Nielsen, 1/23/03

# Liftoff Results – STS-114

## ■ Liftoff Flight Regime

### - Methodology

- Results from STS-114 Liftoff FMA (presented to Loads Panel 1/6/03)
- Load indicator envelope table used to determine max/min values for the ET/SRB aft attach struts (P8/11, P9/12, P10/13) and time of occurrence
- Determined time consistent complement of strut loads

### - Results

	Maximized Strut Indicators					
	P8/11+ (max 154.24)	P8/11- (max -191.62)	P9/12+ (max 202.82)	P9/12- (max -49.56)	P10/13+ (max 62.08)	P10/13- (max -168.90)
P8[kips]	135.73		-29.77	-46.83	68.69	-73.14
P9[kips]	41.60	71.33			86.77	76.56
P10[kips]	-23.69	-52.34	-45.15	-56.28	-21.68	
P11[kips]		-153.38	-2.23	-57.26	59.38	-70.34
P12[kips]	34.37	61.23	177.79	-18.71	86.18	66.30
P13[kips]	-16.67	-31.80	-12.51	-54.66		-49.29
Time[s]*	7.208	7.458	6.817	7.768	7.550	8.503
Case	LO0776	LO0570	LO0505	LO0561	LO0789	LO0703

\* After SSME Ignition



## Liftoff Summary/Forward Plan

---

### ■ STS-107

- Mission specific Liftoff ET/SRB aft attach strut loads delivered to SRB element to assist in material strength issue resolution
- Liftoff flight regime determined to be critical area

### ■ STS-114

- Mission specific Liftoff ET/SRB aft attach strut loads included in this presentation
  - Formal transmittal document (ECD 2/7/03)

### ■ STS-115

- Mission specific Liftoff ET/SRB aft attach strut loads – to coincide with STS-115 Liftoff FMA (ECD 3/3/03)



# High-Q Results – STS-107

## ■ High-Q Flight Regime

- Methodology
  - Results from STS-107 High-Q mission specific launch probability assessment of operational High-Q qbar design target with Light Weight Tank (presented to SIRB 12/4/02, reviewed with Loads Panel chair 12/6/02, and presented to SSEIG 12/9/02)
  - Investigated SRB/ET aft attach indicators FTB7, FTB8, FTB9, and FTB10 based on initial information to supply "SRB" indicators at aft ET attach ring (assume "ET" indicators, P8 through P13, for future work)
  - Results were not provided to SRB Element as the High-Q case was not the issue driver in the final analysis
  - Launch probability analysis:
    - A batch of 150 non-dispersed trajectories derived from 150 mission specific winds provided by GN&C
    - All load indicators were evaluated for each set of 150 trajectories
    - No violations were encountered

# High-Q Results – STS-107

## High-Q Flight Regime

- Indicator results for STS-107 mission specific LWT certification (Lbs.)

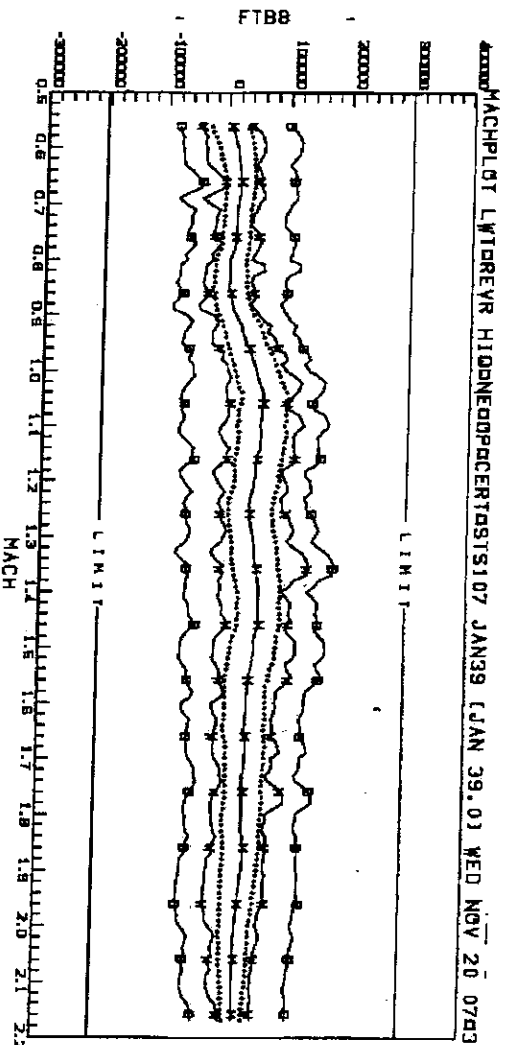
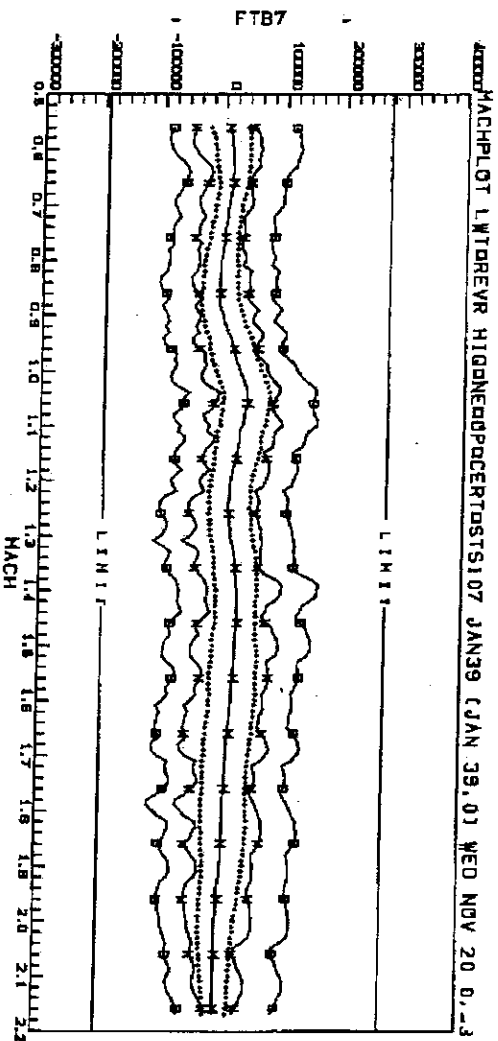
Launch Probability Loads							
(Lwt_rev_hiq_ne_op_cer - STS-107)							
Load Indicator	Load Dir	Nom Load	RSS knockdown	Total Load	Limit	% of Limit	Mach
FTB7 (+)	+Z	104544.64	58860.00	163404.64	275900.00	59.23	1.40
FTB7 (-)	+Z	-71488.24	-45569.20	-117057.44	-195000.00	60.03	1.78
FTB8 (+)	+Z	143167.26	40476.90	183644.16	299900.00	61.24	1.35
FTB8 (-)	+Z	-36606.89	-54675.20	-91282.09	-204700.00	44.59	1.18
FTB9 (+)	+Y	1815.67	25768.80	27584.47	269900.00	10.22	1.05
FTB9 (-)	+Y	-108836.26	-40454.40	-149290.66	-300700.00	49.65	1.55
FTB10 (+)	+Y	118695.48	28838.40	147533.88	306800.00	48.09	1.43
FTB10 (-)	+Y	-1484.24	-23138.70	-24622.94	-296000.00	8.32	1.04

LWT - Total Knockdowns (STS-107)				
Load Indicator	System Disp	Gust	WP	RSS knockdown
FTB7 (+)	52246.70	2836.00	27050.00	58860.00
FTB7 (-)	-34056.40	-4897.80	-29790.00	-45569.20
FTB8 (+)	30054.00	2848.00	27050.00	40476.90
FTB8 (-)	-44933.00	-3414.50	-29790.00	-54675.20
FTB9 (+)	22657.00	718.00	0.00	25768.80
FTB9 (-)	-30079.50	-630.00	-10370.00	-40454.40
FTB10 (+)	24278.10	4344.00	10370.00	28838.40
FTB10 (-)	-19401.20	-7430.00	0.00	-23138.70

# High-Q Results - STS-107

## High-Q Flight Regime

- Mach plots for STS-107 mission specific LWT certification (Lbs.)



### Legend:

..... 95% of winds

M - Undispersed load  
mean wind of the  
month

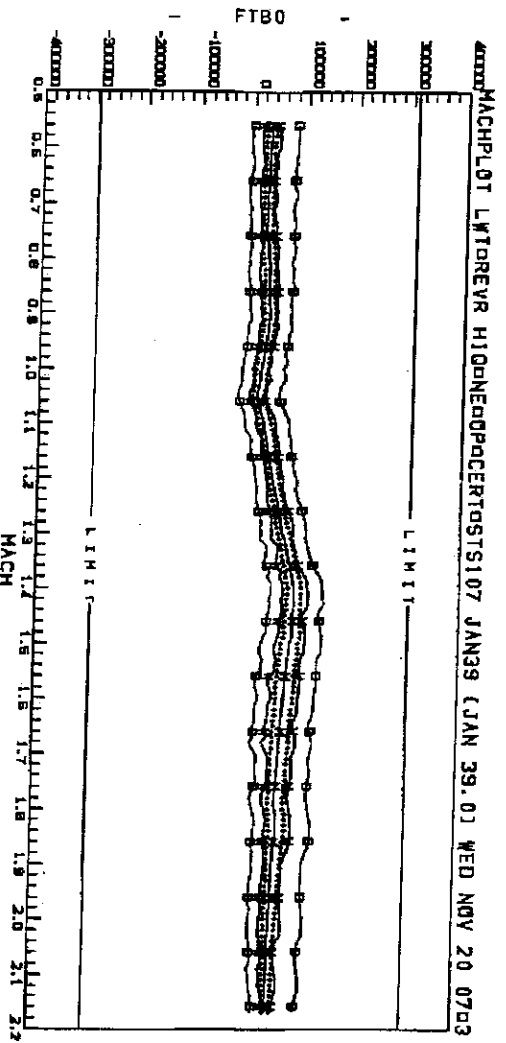
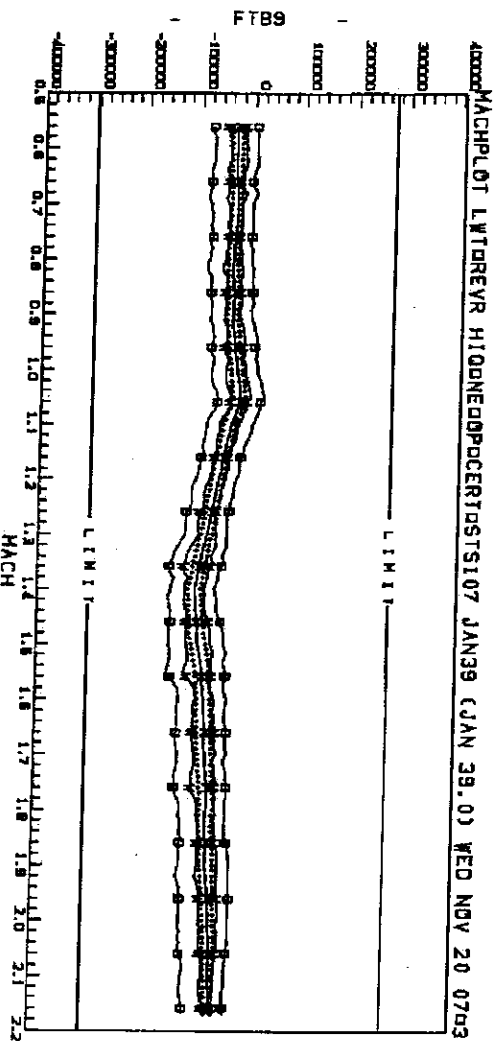
W - Undispersed  
envelope of 150 winds

D - Dispersed  
envelope of 150 winds

# High-Q Results - STS-107

## High-Q Flight Regime

Mach plots for STS-107 mission specific LWT certification (Lbs.)



### Legend:

- ..... 95% of winds
- M - Undispersed load mean wind of the month
- W - Undispersed envelope of 150 winds
- D - Dispersed envelope of 150 winds

# High-Q Results – STS-114 (Compatible)

## High-Q Flight Regime

- Indicator results for PE Operational High-Q Certification of SLWT (Lbs.) (March/51 degrees/nominal energy)

Launch Probability Loads							
(Slwt_revb_hq_ne_op_cert - Mar51_Y00d045)							
Load Indicator	Load Dir	Nom Load	RSS knockdown	Total Load	Limit	% of Limit	Mach
FTB7 (+)	+Z	114873.53	68207.50	183081.03	284500.00	64.35	1.05
FTB7 (-)	+Z	-64709.14	-55383.30	-120092.44	-193100.00	62.19	0.93
FTB8 (+)	+Z	138808.58	44223.70	183032.28	303000.00	60.41	1.39
FTB8 (-)	+Z	-47195.50	-40284.80	-87480.30	-193900.00	45.12	0.82
FTB9 (+)	+Y	-3027.91	25768.80	22740.89	233600.00	9.73	1.05
FTB9 (-)	+Y	-118860.13	-28102.90	-146963.03	-304400.00	48.28	1.40
FTB10 (+)	+Y	113383.51	34012.40	147395.91	280100.00	52.62	1.47
FTB10 (-)	+Y	-75.77	-23011.20	-23086.97	-276000.00	8.36	1.03

SLWT - Total Knockdowns (Mar51-Y00d045)				
Load Indicator	System Disp	Gust	WP	RSS knockdown
FTB7 (+)	55575.00	10226.00	38041.40	68207.50
FTB7 (-)	-37744.40	-7184.80	-38968.10	-55383.30
FTB8 (+)	31056.10	2701.60	31438.90	44223.70
FTB8 (-)	-27162.80	-15703.87	-26312.90	-40284.80
FTB9 (+)	22657.00	8571.00	0.00	25768.80
FTB9 (-)	-21896.70	-16923.00	-13044.20	-28102.90
FTB10 (+)	26953.30	16069.40	17977.20	34012.40
FTB10 (-)	-19472.00	-8804.80	0.00	-23011.20



## High-Q Summary/Forward Plan

---

### ■ STS-107 (Launch 1/16/03)

- Mission specific High-Q ET/SRB interface loads retrieved from launch probability analysis to assist in material strength issue resolution.

### ■ STS-114 (Launch 3/01/03)

- High-Q ET/SRB interface loads retrieved from PE High-Q Operational Certification of SLWT included in this presentation.
- **TASK A:** Perform mission specific "launch probability" assessment (150 mission specific, non-dispersed trajectories from GN&C) and provide knockdown dispersed P8 through P13 indicator loads. Tabulate Mach consistent loads for max/min of each indicator. (ECD 2/4/03)
- **TASK B:** Obtain feedback from SRB Element on utility of approach and need for further relief. Identify comparable current certification loads, and prioritize indicators to max/min for which time consistent loads are needed. (ECD 2/10/03)

# High-Q Summary/Forward Plan

## ■ STS-114 (continued)

- **TASK C:** Perform mission specific, quasi-static time domain assessment to determine time consistent loads with ASCENT code. (ECD 02/27/03)
  - Develop ASCENT inputs based on non-dispersed and dispersed trajectory inputs.
  - Generate mission specific (mass properties) ASCENT math models.
  - Verify that gust dynamics have minimal impact to total load in launch probability assessment to validate quasi-static approach. Otherwise modify inputs or add gust increment to quasi-static results.
  - Proceed on prioritization basis, developing time consistent loads for the selected indicator max or min with the associated set of input conditions.



## High-Q Summary/Forward Plan

### ■ STS-115 (Launch 5/23/03)

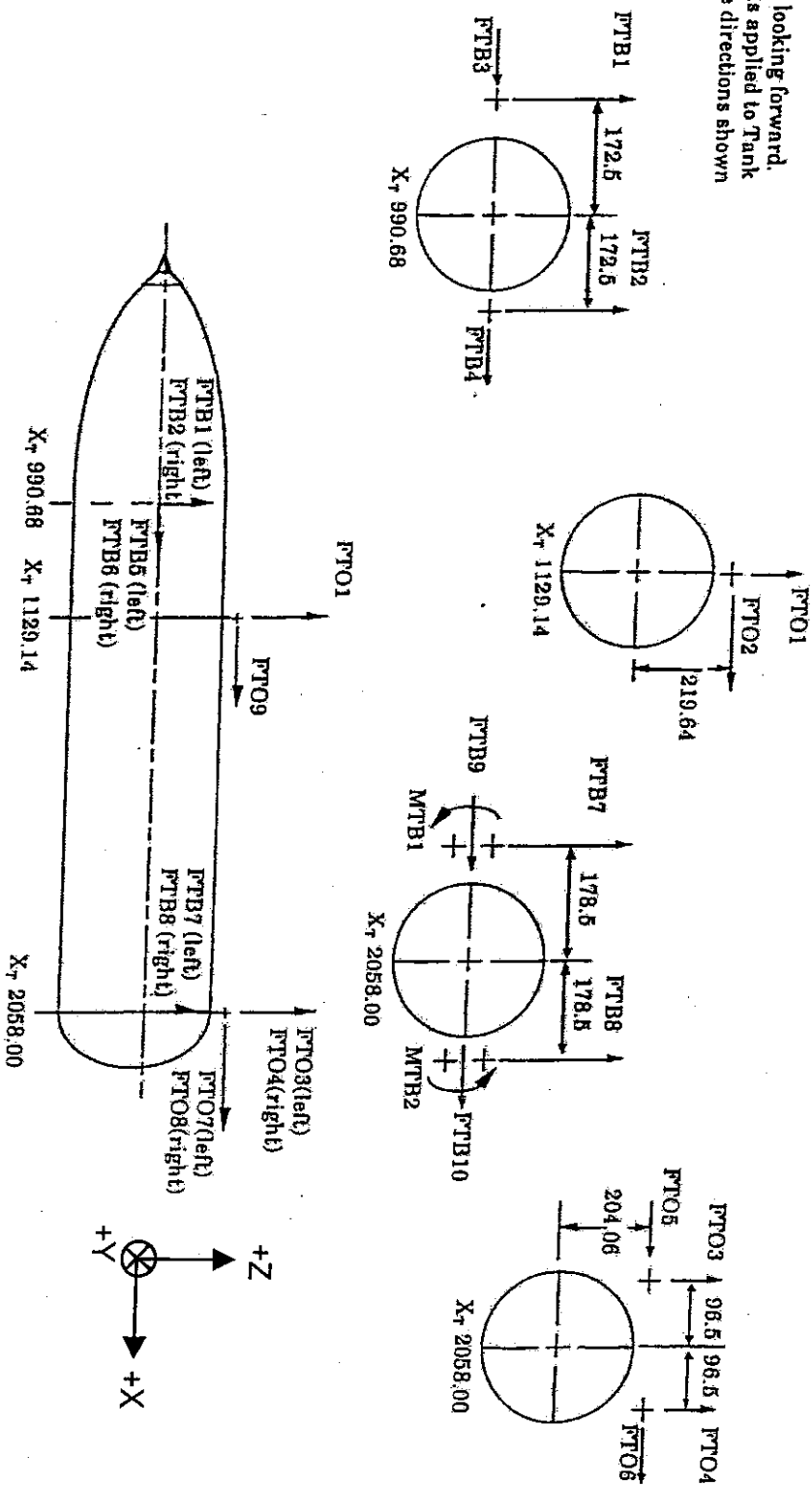
- Perform mission specific "launch probability" assessment (150 mission specific, non-dispersed trajectories from GN&C) and provide knockdown dispersed P8 through P13 indicator loads. Tabulate Mach consistent loads for max/min of each indicator. (ECD 3/11/03)
  - Note that FRR TDDP is not released until 03/28/03
- Perform mission specific, quasi-static time domain assessment to determine time consistent loads with ASCENT code. (ECD 04/03/03)
- Develop time consistent gust loads with ASCENT to be added to quasi-static cases. (ECD 04/21/03)



## Back-up

### Interface Loads Diagram

Section looking forward.  
All loads applied to Tank  
Positive directions shown



# Back-up

## Strut Loads Diagram

